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(54) **CIRCUIT BOARD ASSEMBLY AND BACKLIGHT MODULE COMPRISING THE SAME**

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(30) **Foreign Application Priority Data**

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F21V 29/00 (2006.01)

(52) **U.S. Cl.** **362/294**; 362/373; 361/719; 361/720; 257/706

(58) **Field of Classification Search** 362/97.3, 362/218, 294, 373, 547, 631; 361/719, 720; 257/706
See application file for complete search history.

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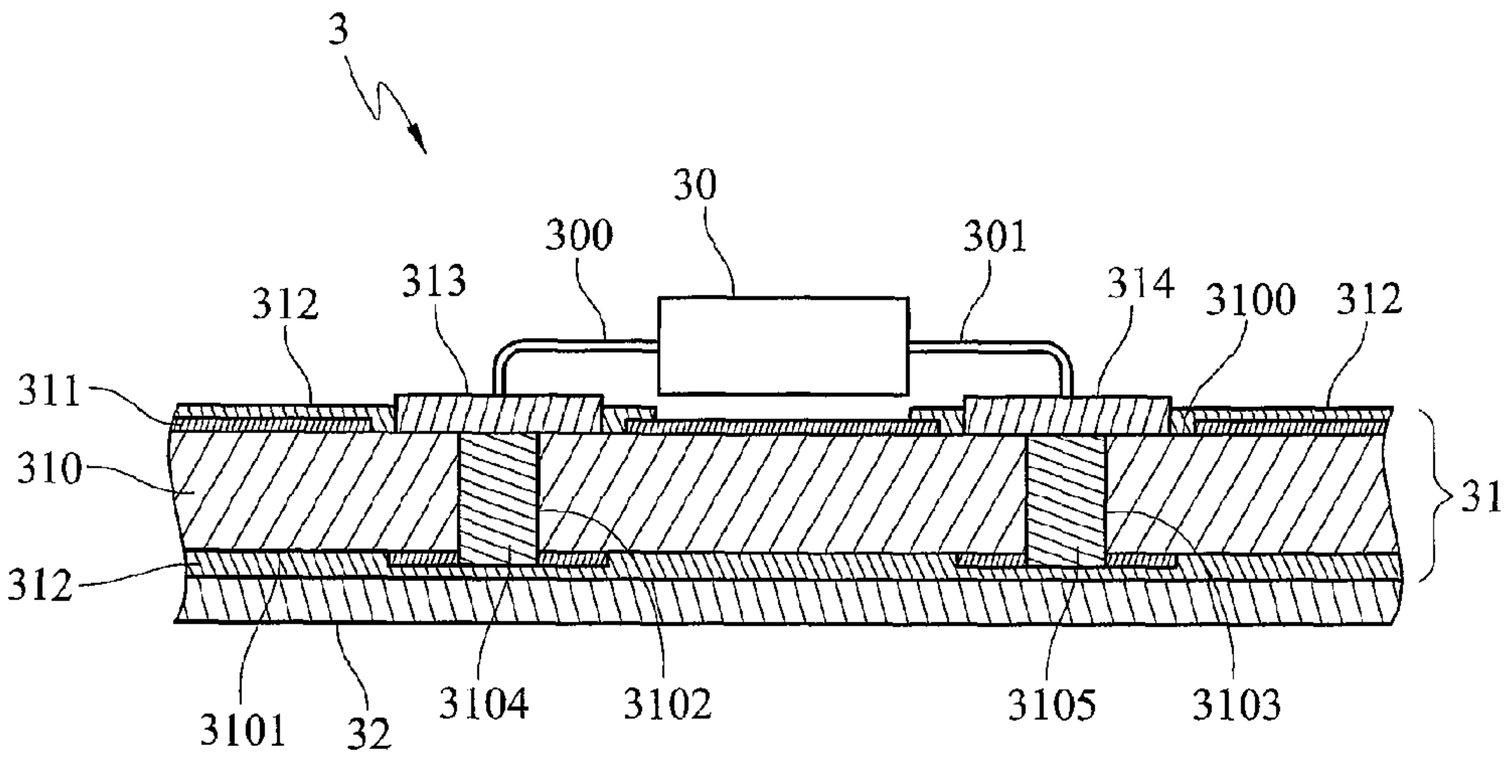
(57) **ABSTRACT**

A circuit board assembly and a backlight module comprising the circuit board assembly are provided. The circuit board assembly has a first surface and a second surface opposite to the first surface, and further comprises at least one laminate, a first conductive wiring structure and a coating. The first conductive wiring structure is formed on the first surface. The coating is formed on the coating area of the second surface, wherein the coating can conduct heat and provide electric insulation. Thus, the circuit board assembly is adapted to outwardly conduct heat from the laminate through the second surface and to promote the heat dissipation efficiency of the circuit board assembly.

20 Claims, 3 Drawing Sheets



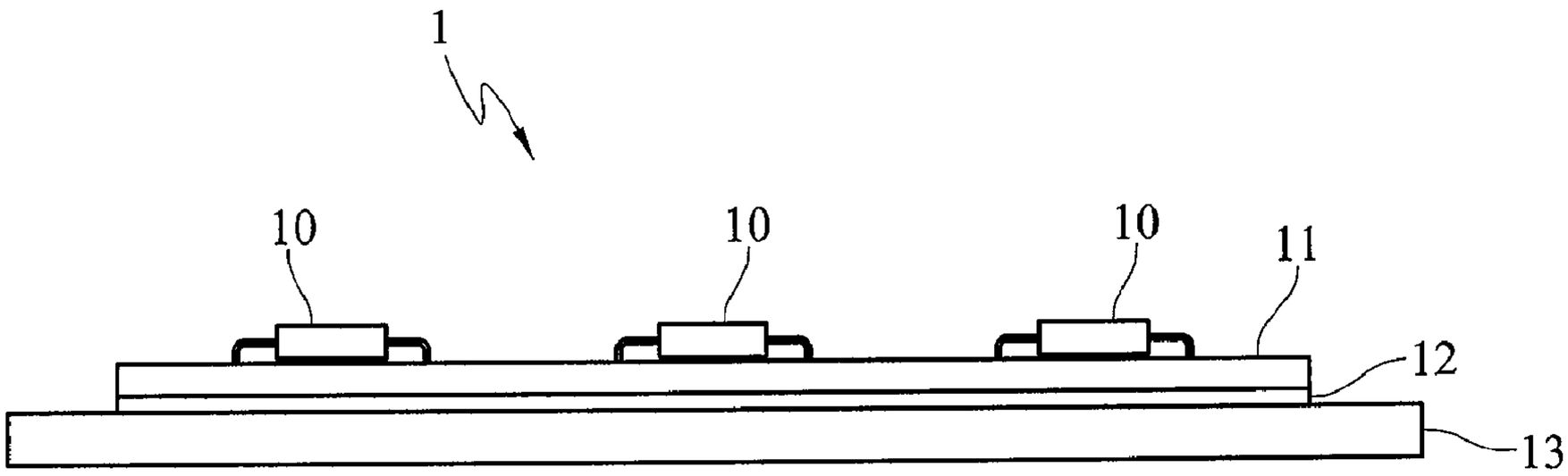


FIG. 1 (Prior Art)

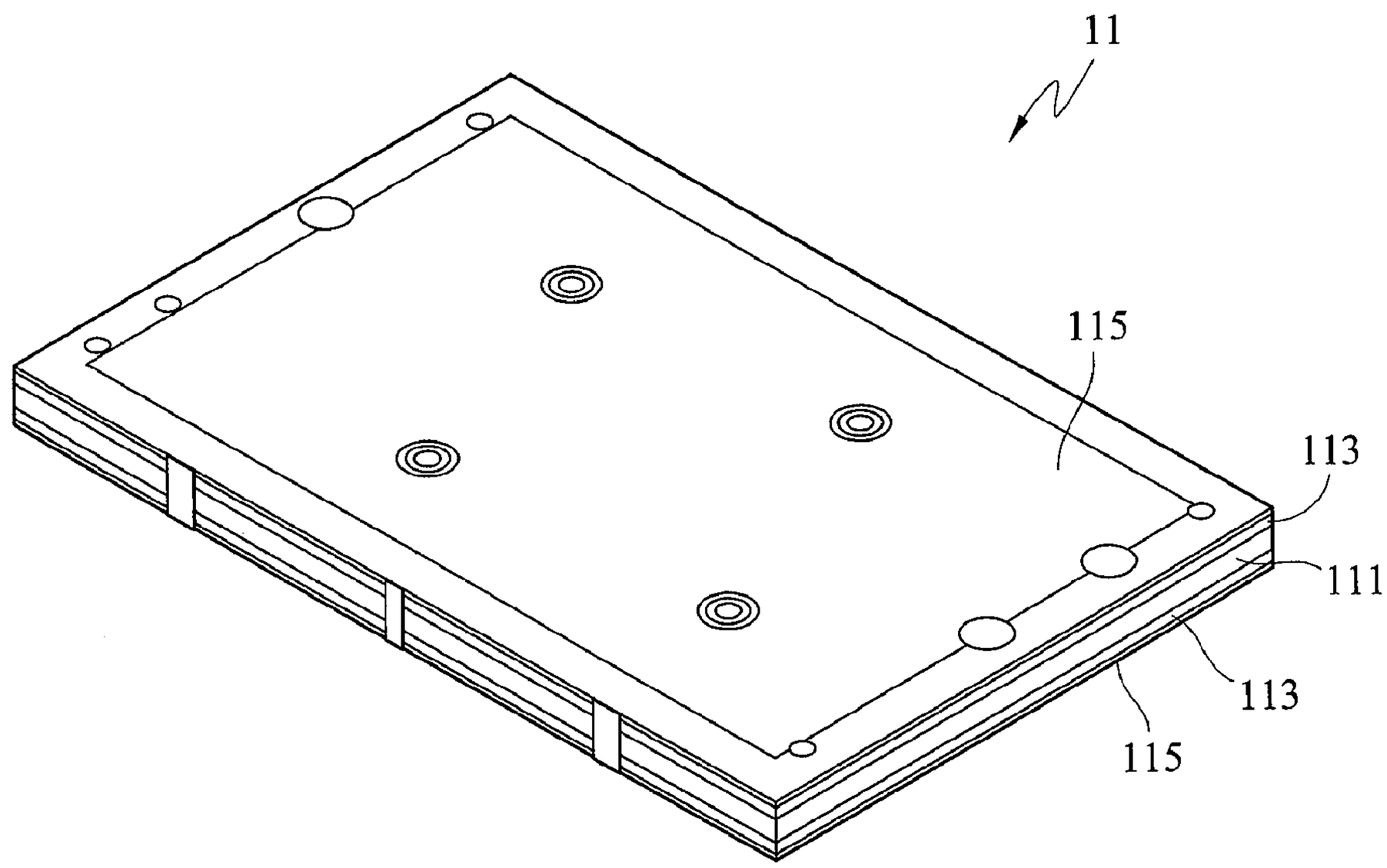


FIG. 2 (Prior Art)

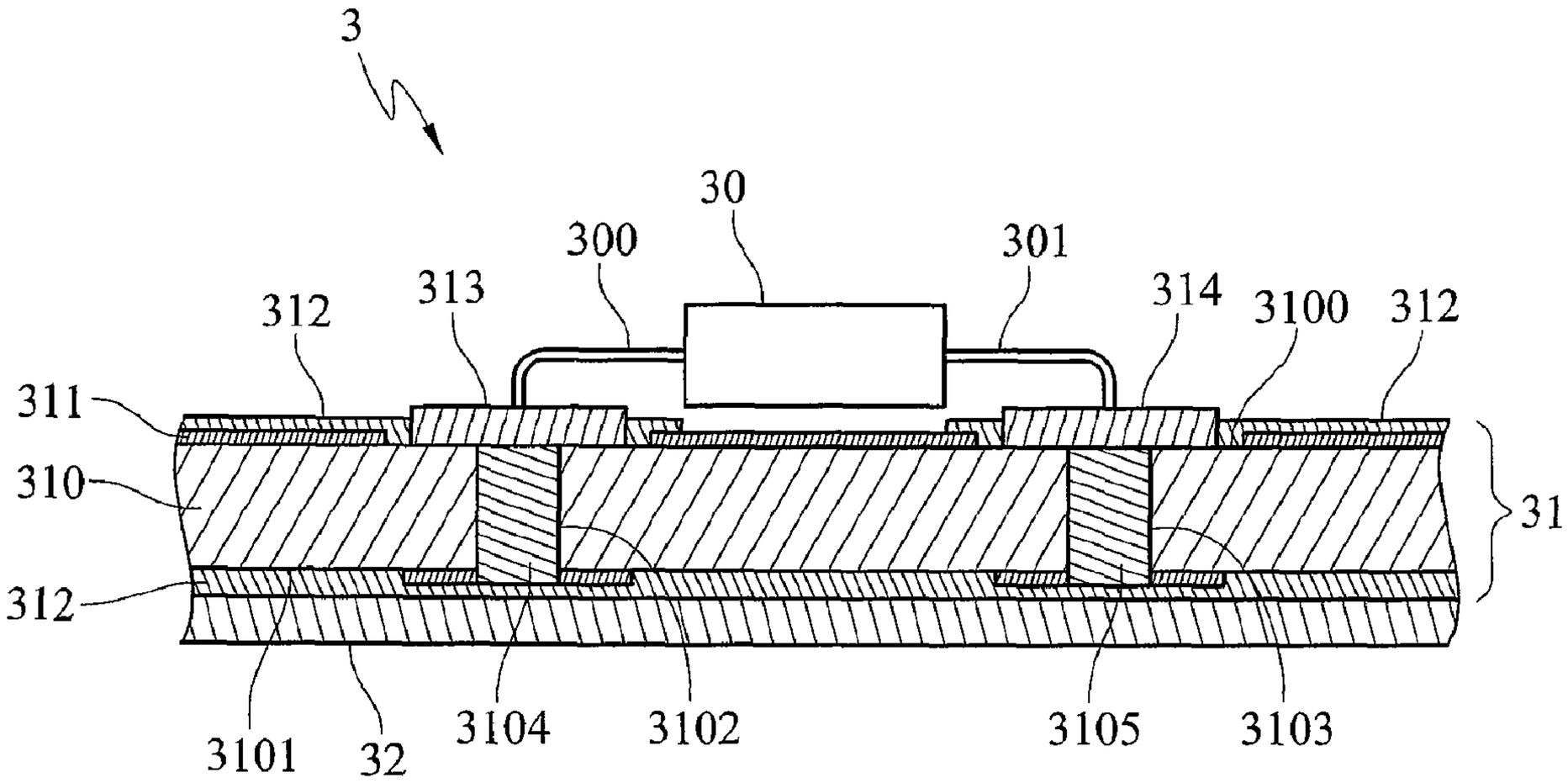

3
30
300
301
312
313
314
3100
312
311
310
31
312
3101
32
3104
3102
3105
3103

FIG. 3

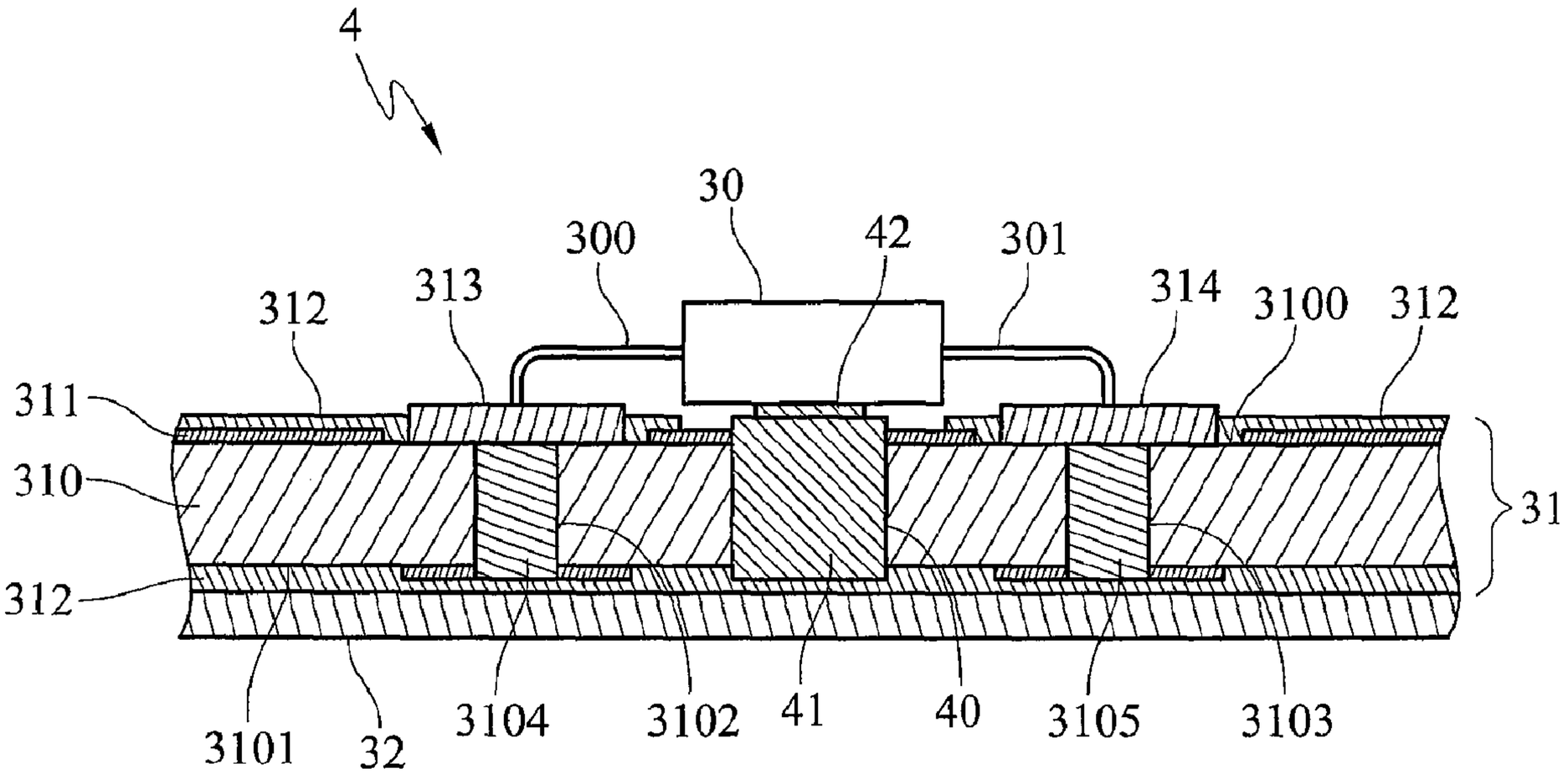

4
30
300
42
301
312
313
314
3100
312
311
310
31
312
3101
32
3104
3102
41
40
3105
3103

FIG. 4

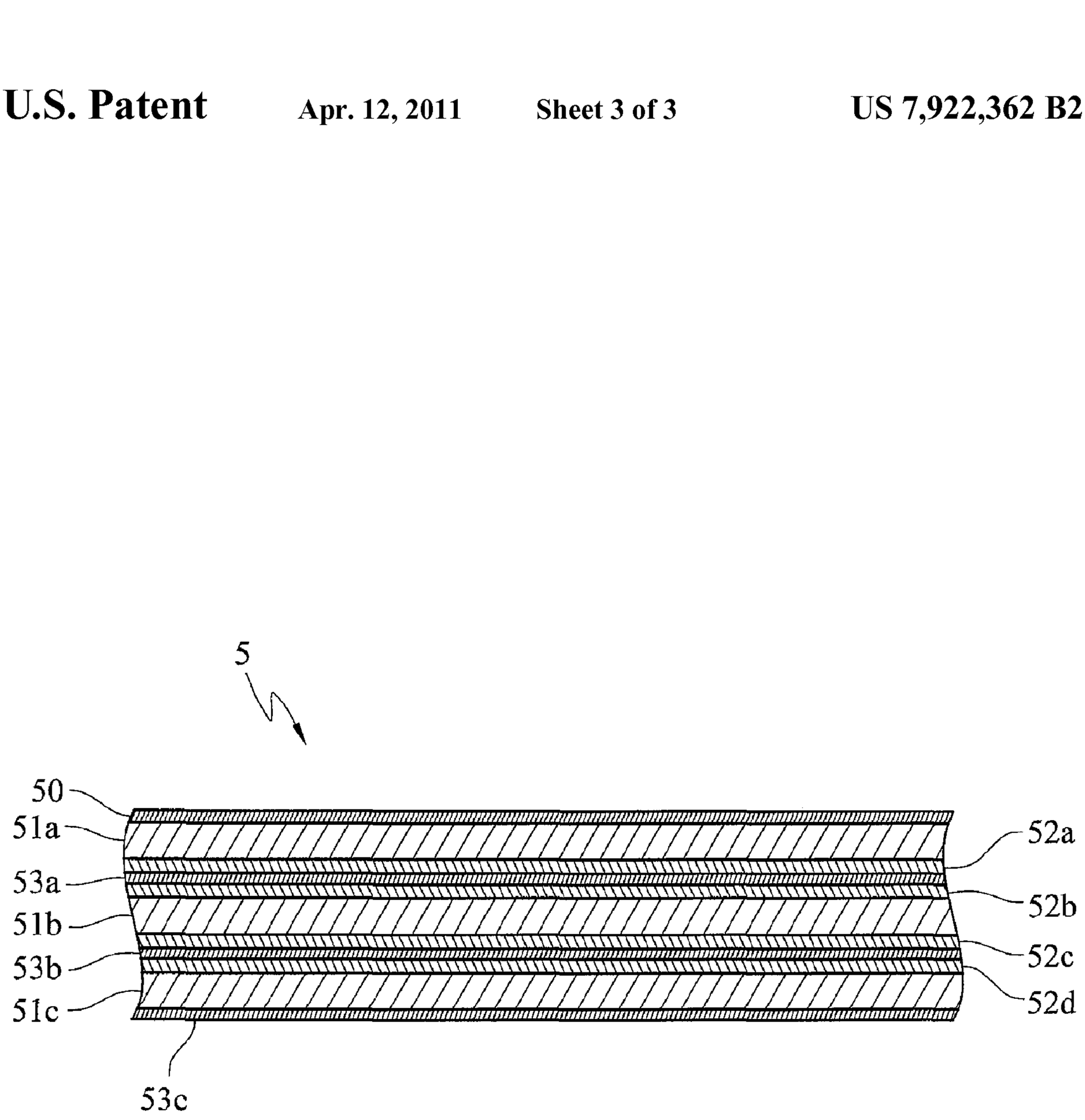


FIG. 5

CIRCUIT BOARD ASSEMBLY AND BACKLIGHT MODULE COMPRISING THE SAME

This application claims the benefit from the priority of Taiwan Patent Application No. 096139247 filed on Oct. 19, 2007, the disclosures of which are incorporated by reference herein in their entirety.

CROSS-REFERENCES TO RELATED APPLICATIONS

Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a circuit board assembly and a backlight module, specifically, a circuit board assembly and a backlight module for use in a liquid crystal display (LCD).

2. Descriptions of the Related Art

Liquid crystal displays (LCD) have many advantages, such as low power consumption, low emission, small footprints, light weight, and is the most commonly used display. Therefore, LCDs have found widespread use in electronic products incorporating display screens, such as mobile phones, digital cameras, personal digital assistants (PDAs) and TV sets. However, since the liquid crystal layer of LCDs does not emit light per se, an additional light source is required. Light emitted therefrom has to be manipulated by the pixel liquid crystals and filtered by a color filter before forming an image on the screen. Generally, the additional light source is known as the backlight module.

FIG. **1** depicts the side view of a backlight module **1** using a light emitting diode (LED) as the light source. The backlight module **1** consists of at least one LED **10**, a printed circuit board (PCB) **11**, a thermo-conductive material **12** and a bezel **13**. The LED **10** is disposed on the PCB **11** to receive the current and various control signals from the PCB **11**. The thermo-conductive material **12** is disposed beneath the PCB **11** to conduct heat from the PCB **11** to the bezel **13** (typically a metallic bezel). This heat dissipation mechanism for the LED **10** will provide a better color uniformity.

As depicted in FIG. **2**, the conventional PCB **11** further comprises a laminate **111** and conductive structures **113** formed on the upper and lower surfaces of the laminate **111** respectively. Usually, a solder-resist layer **115**, typically in a green or brown color is further applied on the conductive structures **113** of the PCB **11**. The solder-resist layer **115** helps to restrict the soldering tin applied only on the specific regions during the downstream process of soldering the PCB **11**. The PCB surface is then protected against pollution, oxidization and short-circuiting during the subsequent soldering and cleaning processes.

However, the conventional solder-resist is made of a material that may retard electro-conduction and thermo-conduction. Although a thermo-conductive material **12** is often applied onto the bottom surface of the PCB **11** in the backlight module **1** of the prior art, the retarding impact exerted by the solder-resist **115** on the thermo-conduction may heavily discount the heat dissipation performance. Eventually, the poor heat dissipation performance of the PCB **11** may lead to uniformity degradation of light provided by the backlight module **1**, thus deteriorating the overall quality of the LCD.

Accordingly, it is important to dissipate heat effectively by eliminating the impact of the solder-resist on the PCB of a backlight module that uses an LED as the light source.

SUMMARY OF THE INVENTION

One objective of this invention is to provide a circuit board assembly with improved heat dissipation efficiency. The circuit board assembly has a thermo-conductive and electro-insulating coating formed thereon to replace the conventional solder-resist coating. The heat dissipation of the circuit board assembly is thereby improved, allowing for the electro-insulating characteristics. To this end, a circuit board assembly disclosed in this invention has a first surface and a second surface opposite to the first surface. The circuit board assembly further comprises at least one laminate, a first conductive wiring structure and a coating. The first conductive wiring structure is formed on the first surface, while the coating is formed on the coating area of the second surface. Both thermo-conductive and electro-insulating, the coating is adapted to outwardly dissipate heat from the laminate through the second surface.

Another objective of this invention is to provide a backlight module with improved heat dissipation efficiency for use in a liquid crystal display (LCD). The backlight module comprises a bezel, a light source, and a circuit board assembly described above. The circuit board assembly has a thermo-conductive and electro-insulating coating formed thereon to replace the conventional solder-resist coating, such that the heat efficiency thereof may be increased by conducting heat to the bezel via the second surface. The heat dissipation, as well as the overall performance of the light source of the backlight module, is improved.

The detailed technology and preferred embodiments implemented for the subject invention are described in the following paragraphs accompanying the appended drawings for people skilled in this field to well appreciate the features of the claimed invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view illustrating the conventional backlight module;

FIG. **2** is a schematic view illustrating the conventional circuit board;

FIG. **3** is a schematic view illustrating an embodiment of this invention;

FIG. **4** is a schematic view illustrating another embodiment of this invention; and

FIG. **5** is a schematic view illustrating a circuit board assembly in accordance with still another embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiments of the backlight module according to this invention will be described in the following paragraphs. As shown in FIG. **3**, without significantly modifying the structure of the conventional backlight module, the backlight module **3** of this invention comprises a light source **30**, a circuit board assembly **31** and a bezel **32**. The circuit board assembly **31** is disposed on the bezel **32**, and may be defined with having the first surface **3100** and second surface **3101** opposite to the first surface **3100**, in which the second surface **3101** faces the bezel **32** and the first surface **3100** is used for arranging the light source **30** thereon. In this embodi-

ment, the light source **30** is an LED, the circuit board assembly **31** is a PCB, and the bezel **32** is a metallic bezel (e.g., a copper bezel). In more detail, the circuit board assembly **31** further comprises at least one laminate **310**, a first conducive wiring structure **311** and a coating **312**.

The first conductive wiring structure **311** is formed on the first surface **3100**. More specifically, the first conductive wiring structure **311** is a group of copper conductors formed on the PCB to electrically interconnect various components disposed on the PCB. The coating **312** is formed at least on a coating area of the second surface **3101**. The coating **312** used in this invention is characterized by its thermo-conductive and electro-insulating properties that can conduct heat from the second surface **3101** of the laminate **310** to the bezel **32**. The coating **312** is made of a material selected from the following group: boron nitride, silicon carbide, aluminum nitride, beryllium nitride, or a combination thereof. However, this invention is not just limited thereto, and the coating **312** may also be made of other materials with both thermo-conductive and electro-conductive properties.

Additionally, the circuit board assembly **31** is further formed with through-holes **3102**, **3103**, which have thermo-conductive structures formed therein respectively. In more detail, a thermo-conductive structure **3104** is formed in the through-hole **3102**, which may fully occupy the through-hole **3102** or just be formed on the sidewalls thereof. Also, a thermo-conductive structure **3105** is formed in the through-hole **3103** in a similar way. As a result, heat may be conducted from the first surface **3100** to the second surface **3101**, and further conducted to the bezel **32** via the coating **312**.

The circuit board assembly **31** further comprises pads **313**, **314** disposed on the first surface **3100** to substantially cover the first through-holes **3102**, **3103** at the periphery thereof. Since the thermo-conductive structures **3104**, **3105**, made of a thermo-conductive material (e.g., copper), are formed in the through-holes **3102**, **3103** and connected to the pads **313**, **314** respectively, the heat generated by the light source **30** may be effectively conducted from conductors **300**, **301**, which is respectively connected with the pads **313**, **314**, to the bezel **32** via the thermo-conductive structures **3104**, **3105** and the coating **312**. The overall heat dissipation efficiency of the backlight module **3** is thereby increased.

In addition, the second surface **3101** of the laminate **310** may also have a conductive wiring structure (not shown) formed thereon. In this case, the conductive wiring structure is formed between the coating area of the second surface **3101** and the coating **312** so that the conductive wiring structure may be covered by the coating **312** for electro-insulation. Additionally, even though the conventional solder-resist coating may be applied onto the first conductive wiring structure **311** formed on the first surface **3100** of the circuit board assembly **31**, the coating **312** is preferably applied on the first conductive wiring structure **311** instead, to further increase the heat dissipation efficiency.

FIG. **4** depicts another preferred embodiment of the backlight module of this invention. The backlight module **4** of this embodiment is substantially the same as the backlight module **3** of the previous embodiment, and therefore only distinct features will be described herein. In this embodiment, to facilitate the heat dissipation from the light source **30**, the laminate **310** may further have a through-hole **40** formed therein, with a thermo-conductive structure **41** disposed in the through-hole **41**. The light source **30** may make contact with the thermo-conductive structure **41** via the heat slug **42** so that heat generated by the light source **30** is conducted directly to the bezel **32** through the heat slug **42**, the thermo-conductive structure **41** and the coating **312**. The overall heat dissipation efficiency of the backlight module is thus increased.

FIG. **5** depicts yet another preferred embodiment of the backlight module of this invention. The circuit board assembly **5** in this embodiment is a multilayered board structure comprising, for example, a plurality of sequentially stacked laminates **51***a*, **51***b*, **51***c*. These laminates **51***a*, **51***b*, **51***c* have at least one electrode layer interposed therebetween, which is depicted as a plurality of electrode layers **52***a*, **52***b*, **52***c*, **52***d* in FIG. **5**. In addition to the coating **53***c* applied onto the bottom surface (i.e., the second surface described in the previous embodiments) of the circuit board assembly **5**, coatings **53***a*, **53***b* are further applied between the electrode layers **52***a*, **52***b*, **52***c*, **52***d* to provide both electro-insulation and thermo-conduction therebetween. Moreover, even though the conventional solder-resist coating may be applied onto the top surface (i.e., the first surface described in the previous embodiments) of the circuit board assembly **5**, the coating **50** is preferably applied instead in this embodiment, thereby to further increase the overall heat dissipation efficiency of the backlight module.

The above descriptions describe the backlight module and circuit board assembly of this invention. The heat generated by the light source of the circuit board assembly is conducted through a both thermo-conductive and electro-insulating coating to the bezel, and is then dissipated outwards. In this way, the overall heat dissipation efficiency of the backlight module is increased, thus improving the heat dissipation. Moreover, the coating of this invention also helps to restrict solder tin being applied only on specific regions during the downstream soldering process and protects the board surface against contamination, oxidization and short-circuit caused during subsequent soldering and cleaning processes.

The above disclosure is related to the detailed technical contents and inventive features thereof. People skilled in this field may proceed with a variety of modifications and replacements based on the disclosures and suggestions of the invention as described without departing from the characteristics thereof. Nevertheless, although such modifications and replacements are not fully disclosed in the above descriptions, they have substantially been covered in the following claims as appended.

What is claimed is:

1. A circuit board assembly, comprising:

at least one laminate defining a first surface and a second surface opposite to the first surface, wherein the at least one laminate is formed with a through hole;

a first conductive wiring structure formed on the first surface;

a thermo-conductive structure formed in the through hole to conduct heat from the first surface to the second surface;

a pad disposed on the first surface to substantially cover the through hole at a periphery thereof; and

a coating at least formed on the second surface at a coating area thereof, wherein the coating is thermo-conductive and electro-insulating, and is adapted to outwardly dissipate heat from the at least one laminate through the second surface.

2. The circuit board assembly as claimed in claim **1**, wherein the coating is made of a material selected from the group comprising: boron nitride, silicon carbide, aluminum nitride, beryllium nitride and the combination thereof.

3. The circuit board assembly as claimed in claim **1**, wherein the thermo-conductive structure is made of a thermo-conductive material, formed in the through hole and con-

nected with the pad, and the thermo-conductive material is a metallic material comprising copper.

4. The circuit board assembly as claimed in claim **1**, wherein the coating is further applied onto the first conductive wiring structure.

5. The circuit board assembly as claimed in claim **1**, further including an insulation coating, at least being applied onto the first conductive wiring structure.

6. The circuit board assembly as claimed in claim **1**, wherein the circuit board assembly is a printed circuit board.

7. The circuit board assembly as claimed in claim **1**, wherein the at least one laminate includes a plurality of laminates which are sequentially stacked, and the circuit board assembly further comprises at least one electrode layer disposed between the plurality of laminates.

8. The circuit board assembly as claimed in claim **7**, wherein the at least one electric layer comprises a plurality of electrode layers disposed between the plurality of laminates, in which the coating is applied between the electrode layers.

9. A backlight module, including:

a bezel;

a light source; and

a circuit board assembly disposed on the bezel, the circuit board assembly including:

at least one laminate defining a first surface and a second surface opposite to the first surface, wherein the second surface faces the bezel and the first surface is provided for the light source;

a first conductive wiring structure formed on the first surface; and

a coating at least formed on the second surface at a coating area thereof, wherein the coating is thermo-conductive and electro-insulating and is adapted to conduct heat from the at least one laminate through the second surface to the bezel.

10. The backlight module as claimed in claim **9**, wherein the coating is made of a material selected from the group comprising: boron nitride, silicon carbide, aluminum nitride, beryllium nitride and the combination thereof.

11. The backlight module as claimed in claim **10**, wherein the circuit board assembly is formed with at least one through hole and has at least one thermo-conductive structure formed in the at least one through hole to conduct heat from the first surface to the second surface.

12. The backlight module as claimed in claim **11**, wherein the at least one through hole includes a first through hole, the at least one thermo-conductive structure includes a first thermo-conductive structure, and the circuit board assembly further includes a pad disposed on the first surface to substantially cover the through hole at a periphery thereof.

13. The backlight module as claimed in claim **12**, wherein the thermo-conductive structure is made of a thermo-conductive material, formed in the through hole and connected with the pad, and the thermo-conductive material is a metallic material comprising copper.

14. The backlight module as claimed in claim **12**, wherein the light source includes a conductive wiring connected with the pad, in which heat is conducted from the light source to the bezel through the first thermo-conductive structure and the coating.

15. The backlight module as claimed in claim **12**, wherein the at least one through hole further includes a second through hole and the at least one thermo-conductive structure further includes a second thermo-conductive structure formed in the second through hole, the light source connected with the second thermo-conductive structure through a heat slug, whereby, heat is conducted to the bezel through the heat slug, the second thermo-conductive conductive structure and the coating.

16. The backlight module as claimed in claim **9**, wherein the coating further is applied onto the first conductive wiring structure.

17. The backlight module as claimed in claim **9**, wherein the circuit board assembly further includes an insulation coating at least being applied onto the first conductive wiring structure.

18. The backlight module as claimed in claim **9**, wherein the circuit board assembly is a printed circuit board.

19. The backlight module as claimed in claim **9**, wherein the at least one laminate includes a plurality of laminates which are sequentially stacked, and the circuit board assembly further comprises at least one electrode layer disposed between the plurality of laminates.

20. The backlight module as claimed in claim **19**, wherein the at least one electrode layer comprises a plurality of electrode layers disposed between the plurality of laminates, in which the coating is applied between the electrode layers.

* * * * *